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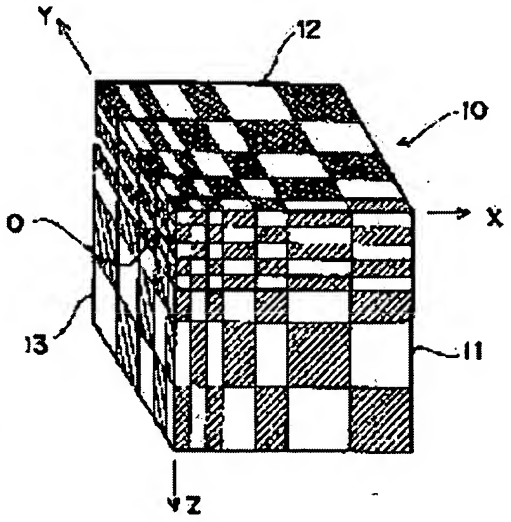
(54) THREE-DIMENSIONAL PATTERN FOR CALIBRATION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an accurate calibration even with zooming with one pattern, by creating a calibration pattern by changing a photographing magnification by zooming so that average grain size of a photographed image of the photographed pattern is uniformed.

SOLUTION: A calibration pattern 10 is cubic, a front surface 11, an upper surface 12, and a left surface 13 are provided with a pattern of the same size, a part at an origin O in three-dimensional coordinates is small in size, and the size increases outward. Respective surfaces of the pattern need not same, but coordinates of a marked point, for example a corner point of a black portion having oblique lines are made clear. Therefore, a size with a large number of digits and a size with a irrational number are avoided, and each pattern for forming the pattern is a pattern easy to provide a corresponding point and is not limited to square and rectangle. For example, when a checkered pattern in which the size is changed in geometrical series is applied a substantially same pattern goes into a photographing screen regardless of zooming, reference point coordinates are easily determined, and calibration is facilitated.



LEGAL STATUS

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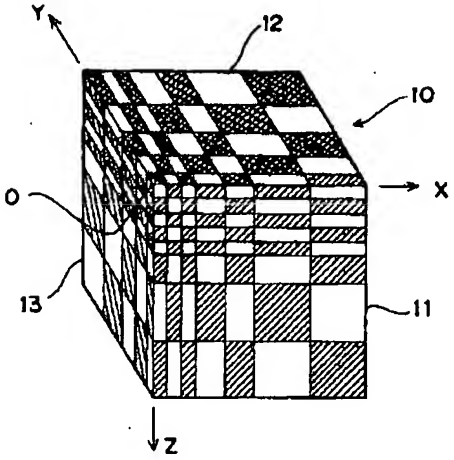
* NOTICES *

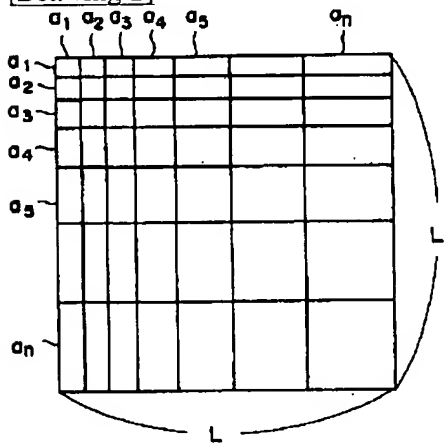
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

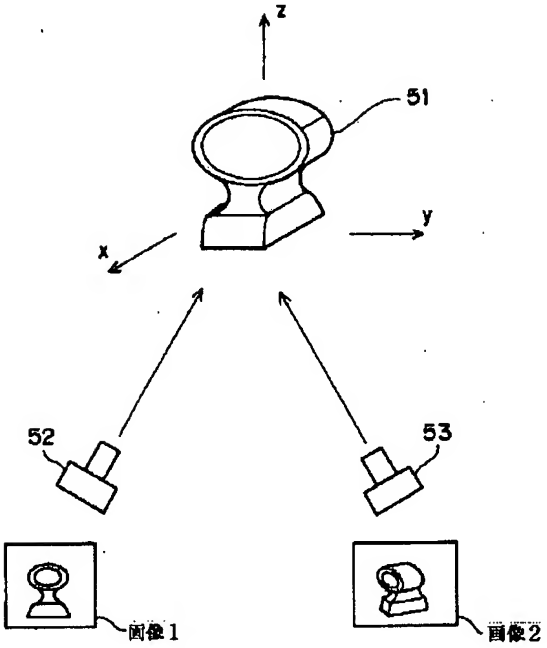
[Drawing 1]



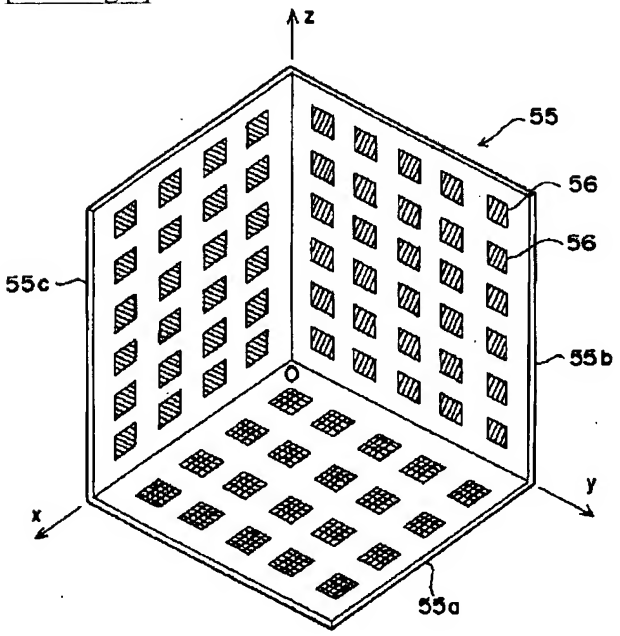
[Drawing 2]



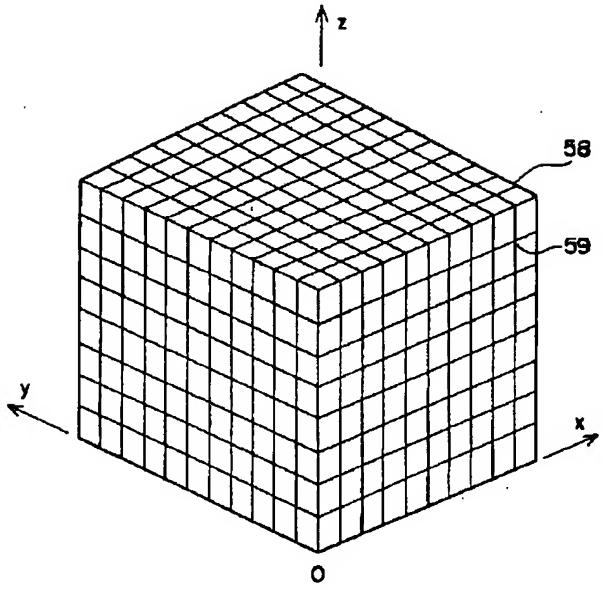
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention belongs to the technical field for recognizing the configuration of a three-dimension body etc. from the photography image which used the zoom type camera. Furthermore, it belongs to the technical field of the three-dimension pattern for the calibrations at the time of specifically using a zoom type camera.
[0002]
[Description of the Prior Art] In the three-dimension image measurement which recognizes the configuration of the object object in three-dimension space, it is necessary to get to know a camera parameter (or for it to also be called a system parameter). It asks by surveying the focal distance of a lens in quest of a camera parameter, or measuring the location and position of a camera, and exact measurement is difficult for such an approach, and it also requires time amount. Then, the body with which a three-dimension coordinate serves as criteria possessing the point which is known is photoed, and the method of asking for a camera parameter from the response relation between the known three-dimension coordinate and the coordinate of the point on the image which photoed it, or the approach of proofreading (calibration) is adopted from the former.
[0003] In order to measure the configuration of the object object 51 in three-dimension space, as shown in drawing 3 , the photography image 1 and the photography image 2 with cameras 52 and 53 of known [parameter / camera] are required. In order to ask for the camera parameter of a camera 52 (or camera 53), two equations will be obtained, if the calibration pattern which attached the point (X, Y, Z) which serves as criteria by the three-dimension space-coordinates system instead of the object object 51 is arranged and the coordinate (Xc, Yc) (graphic display abbreviation) of the image of the reference point of the photography image 1 (or photography image 2) with a camera 52 (or camera 53) cuts by the lot. Therefore, the camera parameter containing 12 unknowns is called for by getting to know the coordinate of the photography image of at least six reference points which are not on the same flat surface.
[0004] The example of the calibration pattern used for drawing 4 and drawing 5 from the former is shown. The calibration pattern 55 shown in drawing 4 consists of x-y flat-surface 55a, y-z flat-surface 55b, and z-x flat-surface 55c, and the mark 56 of known [location / coordinate] is drawn on each flat surfaces 55a-55c. In addition, a mark 56 does not need to be the same. Moreover, the calibration pattern 58 shown in drawing 5 R> 5 draws the grid 59 of criteria spacing on a cube.
[0005] by the way, the magnitude of the object object in three-dimension space -- size -- photography is performed by the camera with not a camera but the zoom lens of a fixed focus when changing variously. If zooming is carried out, a focal distance will change and a photography scale factor will also change. If a focal distance is lengthened (short), a photography scale factor will become large (small). At this time, since the value from which a system parameter also differs is taken, it is necessary to ask for a parameter again. Since the magnitude and spacing of a mark etc. were abbreviation identitas, when it carries out zooming and the

photography scale factor was changed by the conventional calibration pattern, there were too many numbers, such as a mark photoed by the photography image, in being too few, and they were inconvenient. Moreover, whenever it carried out zooming, using a calibration pattern different [every] had a fabrication and handling activity top disadvantage.

[0006]

[Problem(s) to be Solved by the Invention] A calibration pattern is changed for every zooming, there are too few numbers, such as a mark, or this invention aims at and a calibration preventing incorrectness or becoming difficult, as a result of using one calibration pattern, when a three-dimension object object is measured with a camera with a zoom lens. [too] Even if this invention was made under the above backgrounds and carries out zooming by one pattern, it makes it the technical problem to offer the calibration pattern which can be proofread to accuracy.

[0007]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention has adopted the following means. That is, invention according to claim 1 is characterized by constituting a pattern so that the average grain size of the photography image of the calibration pattern which changed the photography scale factor by zooming and was photoed in the three-dimension pattern for calibrations for recognizing the configuration of a three-dimension body etc. from the photography image of a zoom type camera may carry out entropy. In addition, grain size means the consistency of the pattern of a pattern, or roughness and fineness. That is, it means that the pattern of a pattern is coarse in grain size being large, and means that the pattern of a pattern is dense in grain size being small. Moreover, the camera which was not restricted to the camera using a mechanical zoom device, but used an electronic zoom is sufficient as a zoom type camera.

[0008] Invention according to claim 2 is characterized by making coarse grain size of the three-dimension pattern of the periphery section photoed when grain size of the three-dimension pattern of the center section photoed when a photography scale factor is enlarged in the three-dimension pattern for calibrations for recognizing the configuration of a three-dimension body etc. from the photography image of a zoom type camera is made fine and a photography scale factor is made small .

[0009] Invention according to claim 3 is characterized by said three-dimension pattern changing the magnitude of grain size in abbreviation geometrical series in invention according to claim 1 or 2.

[0010] Invention according to claim 4 is characterized by said three-dimension pattern containing the straight-line part for making the distortion parameter of a lens easy to ask in invention according to claim 1 to 3.

[0011] Invention according to claim 5 is characterized by for said three-dimension pattern having given the pattern to three fields of a cube or a rectangular parallelepiped, and constituting it so that the field of these three individuals may turn into a photography side in invention according to claim 1 to 4.

[0012]

[Embodiment of the Invention] Drawing 1 shows the general drawing of the calibration pattern by the operation gestalt of this invention, and drawing 2 is drawing explaining the magnitude of each pattern. Hereafter, the operation gestalt of this invention is explained with reference to a drawing.

[0013] In drawing 1 , the calibration pattern 10 is a cube and the pattern for calibrations is given to the transverse plane 11, the top face 12, and the left lateral 13. This pattern is the pattern of the same size also as each sides 11-13, and size is large as the part of the zero O (near side) of a three-dimension coordinate (X, Y, Z) has small size and it goes outside. The pattern of each side does not need to be the same, and although you may differ, the coordinate of the salient point of the black part which attached the point used as a mark, for example, a slash etc., must be clear. Therefore, the large dimension and the dimension like the irrational number of a digit count must be avoided. Moreover, each pattern which forms a pattern has the desirable thing of corresponding points which seems to be easy to search for, and is not limited to a square and a rectangle.

[0014] Drawing 2 is the case where the checker to which the dimension was changed in geometrical series is

attached. In drawing 2 , die-length [of one side] L of a square 11 was set to 1200mm, and the range of zooming was made into (1 time to 3 times) for the photography scale factor. As shown in drawing 2 , in order to form the pattern of a square or a rectangle, the direction of X and the direction of Y are divided, and it is the die length of each side a1 and a2 ... It is referred to as an. the ratio of the maximum side an -- the an pair L (an/L) -- R -- carrying out -- the ratio of geometrical series -- r, then an+ ... it is set to +a2+a1=an (1+r+r2+ .... +rn) =L. It will be L=an if the value after ** (n+1) of r is disregarded {1/(1-r)}. It becomes. R=1-r It becomes.

[0015] It is set to R=1/4, then r=3/4. if the die length of each side is suitably rounded off so that it may be referred to as n= 18 and may be set to L= 1200mm -- {-- a18 and ... a3, a2, and a1} are set to {300, 225, 165, 120, 100, 75, 55, 40, 30, 20, 20, 10, 10, 10, 5, 5, 5, 5}. However, the unit of the above-mentioned numeric value is mm. A square and a rectangle are constituted on a cube by making the die length of each side into the above-mentioned numeric value, and calibration Batang will be obtained if a pattern is attached suitably. By this pattern, when it is 1 time (min) the photography scale factor of this (i.e., when the focal distance of a zoom lens is the shortest), a photography screen becomes the largest and a 1200mm whole pattern goes into a photography screen from 18 patterns O from the minimum element to the maximum element, i.e., a zero. Moreover, when a photography scale factor is increased 3 times (max), a photography screen becomes the narrowest and 14 patterns from Zero O to 390mm go into a photography screen. In addition, although the above-mentioned numerical example explained the case of n= 18, this invention may not be restricted to this, and n may be smaller than 18 or may be large.

[0016] Since this operation gestalt was constituted as mentioned above, when it is 1 time the photography scale factor of this, even the square whose die length of the side of the maximum square is 300mm goes into a photography screen, and when it is 3 times the photography scale factor of this, the square to 100mm goes [the die length of the side of the maximum square] into a photography screen. Therefore, since the pattern of abbreviation identitas goes into a photography screen regardless of zooming, it is easy to search for the coordinate of an origin/datum, and the effectiveness of being easy to do a calibration is acquired. Moreover, since the straight-line part is contained in Batang, even if there is distortion of a lens, the distortion can be detected easily and it is effective in a distortion check being easy. Moreover, since he is trying for the rank of a coefficient matrix not to fall in case this operation gestalt gives the calibration pattern to three cubical fields, a normal coordinate can be chosen from each side and a projective-transformation matrix is calculated, it is effective in count becoming easy.

[0017] As mentioned above, although the operation gestalt of this invention and the example have been explained in full detail with the drawing, a concrete configuration is not restricted to this example, and even if there is modification of a design of the range which does not deviate from the summary of this invention etc., it is included in this invention. For example, the configuration which attached the calibration pattern is not limited to a cube or a rectangular parallelepiped. Moreover, a calibration pattern should just be a pattern with which entropy of the average grain size is carried out as it is not limited when there is a part with a fine grain size in the center and a part with a coarse grain size is in a perimeter, the pattern that grain size is coarse is omitted when a photography scale factor is enlarged (it is about a focal distance), and the pattern that grain size is coarse enters, when a photography scale factor is made small (it is about a focal distance).

[0018] In addition, the camera using an electronic zoom is sufficient as a zoom type camera. That is, this invention is applied when using the zoom type camera equipped with the electronic zoom which obtained the image more than the scale factor which carries out interpolation processing of the picture signal outputted from a photography component, and is obtained from a actual lens focus, or a video camera.

[0019]

[Effect of the Invention] As explained above, according to the configuration of this invention, entropy of the average grain size is carried out regardless of the magnitude of the photography scale factor by zooming, Batang of abbreviation identitas can be put into a photography screen, and the effectiveness that the

calibration of a parameter is easy is acquired. In invention according to claim 4, further, since a straight-line part is included in a pattern, the effectiveness that extent [lens] of distortion can be recognized is acquired. In invention according to claim 5, since the cube etc. is used, in case a projective-transformation matrix is calculated, the effectiveness that there is no omission of the rank of a coefficient matrix and count becomes easy, and the effectiveness that a fabrication is easy are acquired.

[Translation done.]